

## **Critical Habit Review**

### **General Comments**

The endangered status of Southern Resident Killer Whales (SRKW's) does not appear to be due to directed takes (in contrast to the late 1960's when removals for public display resulted in the rapid population decline of an already small population). Therefore, habitat degradation appears to be the main cause of their status. Recent fluctuations in population size suggest SRKW's are close to the maximum population size supported by their habitat in its current state.

This leads to two conclusions. One, the entire range of Southern Resident Killer Whales is currently incapable of supporting a population of resident killer whales with long-term viability. Two, since the range is unlikely to expand, improvement in existing habitat quality will be required to recover the population.

The use of the inland waters of Washington State by SRKW's is well documented. However, most of the time, locations of Southern Resident Killer Whales are unknown. Thus occupancy rates of the majority of the range is unknown. It is likely that much of the poorly studied waters is rarely used, and hence is less important than the frequently used inland waters. However, it is also likely that core areas exist in the outer coast waters, which may have importance comparable to the inland waters.

Thus habitat usage can be characterized based on research effort and occupancy as follows. Much of the inland waters of Washington and British Columbia are well-studied and frequently occupied. A portion of the inland waters are well-studied, and known to be rarely occupied. A large portion of the Pacific Coast is poorly studied, and known to be at least rarely occupied.

Studies of resident killer whales have shown they have the potential to roughly double in population every 25 years. Three doublings in population size may be required for the population to be downlisted or delisted. That is recovery, is likely to take at least 75 years, even if all possible recovery steps are promptly implemented.

Southern Resident Killer Whales are highly dependent on anadromous fishes (salmon). Thus the quality of unoccupied habitat is important to the quality of occupied habitat. Further, the oceanic range of salmonid prey extends beyond the known range of Southern Residents. That is, protection of the entire occupied range of the species would be insufficient to ensure the recovery of the population in the absence of improvement of unoccupied habitat. It may require restoration of large salmonid species to roughly 50% of historic levels to support a viable population of SRKW's.

Thus we can identify the following habitat types. A portion of the range is known to be frequently occupied, and can clearly be designated critical habitat. Another portion of the range is known to be rarely occupied. For the time being, all of this habitat may be critical, but its importance may decline as other habitat is improved. Another portion of the range may be described as "data deficient." As with the well studied portion of the range, all of this habitat may be critical at this time. As additional data are obtained, a portion of the range may be identified as clearly being critical habitat. Similarly, much of the outer coast waters portion of the range may decline in importance as core habitats are restored.

In addition, one can identify unoccupied habitat that is critical to maintaining the population at its current level. As with occupied habitat, some of this habitat is likely to remain critical throughout the recovery period. Similarly, some habitat may decline in importance as other parts are restored.

Even under ideal conditions, killer whales are only likely to be able to increase at 3% a year. That is, habitat improvement in excess of this will not accelerate recovery. Thus critical habitat should be treated as dynamic. There needs to be an initial increase in habitat quality of sufficient magnitude to allow the population to increase at its maximum rate. After that, habitat improvement can slow down without harm, as long as it improves at 3% a year to ensure steady growth.

*Example.* Vessel traffic may reduce effective prey availability. Reducing vessel effects would result in a rapid increase in habitat quality, which combined with the recent favorable shift in the Pacific Decadal Oscillation, may allow the population to increase at its maximum rate for several years. Subsequently, many small scale salmon enhancement projects may cumulatively provide the necessary 3% annual improvement in habitat quality. From time-to-time, large scale improvements (e.g., dam removal) may result in larger improvement. Eventually, sufficient salmon production will be restored to support a viable killer whale population. At that point, less important runs could be removed from critical habitat status. Likewise, at some point much occupied habitat will decline in importance to the point that it is no longer critical.

*Designation of Unoccupied Critical Habitat versus habitat where actions may result in adverse of modification of Critical Habitat.* It will be important to designate unoccupied habitat as critical habitat rather than evaluating actions in terms of their effects on occupied critical habitat. As noted above, current habitat conditions cannot support a viable population of Southern Resident Killer Whales. Thus it is likely that new spawning habitat for salmon needs to be established. An action precluding spawning in the future could preclude adequate habitat restoration, although there would be no immediate impact on critical habitat, if the habitat were unoccupied by whales and their potential prey (production cannot drop below 0, but it could be prevented from rising above 0). Habitat where killer whale prey currently spawn needs to be protected as well. However, actions that adversely modify such habitat would adversely modify critical habitat and could be protected indirectly. For clarity, it may help to designate such habitat as critical, though in principle it should be redundant.

Due to the highly mobile nature of whales, their prey, and the waters they live in, it must be recognized that actions outside the occupied range of killer whales may adversely modify their habitat. Destruction of salmon spawning habitat would reduce prey density in occupied critical habitat. Production of high levels of noise outside of critical habitat may adversely modify occupied critical habitat. Chemicals and pathogens may be transported from outside of critical habitat into critical habitat. That is, it will be important to recognize that in addition to proposed activities within critical habitat, there will be a large buffer zone in which actions need to be carefully evaluated for potential effects on critical habitat distant from the action area. It will expedite the decision making process for NMFS to highlight “buffer zones” where actions are likely to adversely modify critical habitat.

*Canadian habitat.* In addition to habitat within the United States, habitat critical to the long-term survival of SRKW's is found in Canada. While the United States cannot control Canadian territory, the U.S. Government does fund and/or regulate many activities of its own citizens that take place in Canada. Examples include scientific research, military activities, and maritime traffic. It is important that NMFS highlight habitat within Canada to ensure that Section 7 consultations will take place whenever they are appropriate.

*Evaluation at the policy level rather than the action level.* Due to the large range of killer whales, and the still larger area of their ecosystem, many similar actions will be taken. E.g., many permit applications to develop areas near salmon streams may be expected. These individual projects will have small effects on overall salmon abundance, and decisions to approve individual permit applications are likely to be supported on the basis that the individual action is not likely to be significant. However, the cumulative effect of all such applications likely would be significant. That is, the action to adopt a policy allowing modifications below a certain size may result in significant adverse modification of critical habitat, although none of the individual actions taken by themselves would result in significant adverse modification of critical habitat. This concept is followed in legislation such as the Clean Air Act, where emissions of individual vehicles are likely to have negligible consequences, but standards are set for the fleet of vehicles as a whole, in order to limit the cumulative effect to acceptable levels.

*Summary.* A precautionary approach to recovery would require designating all occupied habitat as critical. Further, all unoccupied habitat contributing to the prey base would be critical. However, as recovery progresses, marginal habitat, both occupied and unoccupied, could be removed from critical status. A non-precautionary approach would require increasing critical habitat designations as new data become available. It would probably take at least five years to demonstrate regular use of particular portions of outer coast waters. Alternatively, techniques have been developed with other species to extrapolate habitat usage based on limited sightings by examining the physical and biological features where sightings occurred, and quantifying the degree to which such features are found elsewhere in the range. NMFS will need to decide whether to be precautionary, both in terms of the consequence of that decision on its ability to recover killer whales, and the economic consequences of allowing investment in activities which ultimately cannot be allowed to proceed versus delaying activities that could have been allowed to proceed without impairing recovery.

### *Essential Habitat Constituents and Adverse Habitat Modification*

*Clean air.* Respiratory illnesses are a leading cause of death for captive cetaceans, reflecting the loss of ability by cetaceans to cope with airborne contaminants due to a marine existence. NMFS must prevent adverse habitat modification by factors such as vessel exhaust, vehicle emissions, refineries, and other sources of air pollution. Airborne contaminants are highly mobile, so activities distant from critical habitat may lead to adverse habitat modification.

*Clean water.* There are several classes of potential adverse habitat modification that NMFS must address. These include acute toxins (e.g., oil), chronic toxins (e.g., PCB's and PBDE's) and biological contaminants (e.g., sewage and run-off may contain pathogens and contribute to harmful algal blooms). As with air, water is highly mobile, so distant activities may modify critical habitat.

*Prey.* Many prey characteristics need to be considered. These include species, size, nutritional status, toxin content, pathogens and parasites. Further, density must be sufficient to not only support individual survival, it must support large groups of individuals that characterize resident social organization. In addition, prey distribution must be sufficiently continuous spatially to support movement between ephemeral high quality prey patches. Due to the life history of Chinook salmon, an important prey species, actions in terrestrial habitat near aquatic spawning and rearing habitat may adversely modify critical habitat of killer whales. Further, the marine feeding range of salmon extends far beyond the range of SRKW's, so distant actions in the marine environment may adversely modify critical habitat.

*Acoustic characteristics.* Moderate levels of noise may interfere with echolocation (and hence reduce foraging efficiency) and communication, and Williams et al. 2002 estimated that 105-110 dB re 1  $\mu$ Pa noise was sufficient to cause significant behavioral changes. Noise may also lead to stress. High levels of noise may lead to temporary or permanent injury to hearing. Sources of noise include vessel traffic, scientific research, military activities, construction, aquaculture, and energy farms. Intense sources of noise, such as airguns and military sonars, may travel sufficient distances for actions outside critical habitat to adversely modify critical habitat. Actions outside critical habitat that lead to increased vessel traffic within critical habitat may also adversely modify critical habitat.

*Safe Passage.* Core areas are separated from each other by less frequently used habitat. However, safe passage within and between core areas would need to be ensured. Safe passage needs to be perceived as such by killer whales, as well as in actuality. Examples of where safe passage was not recognized as such by killer whales include entrapments (Barnes Lake [2 whales died there], Dyes Inlet [2 whales died shortly after they left]), the Broughton Archipelago [where AHD's formed an acoustic barrier] and perhaps the Hood Canal Bridge. That is, habitat which naturally lacks sufficient prey to clearly merit critical habitat designation may need to be managed as critical habitat because it provides a corridor between core areas. Noise, vessel traffic, construction, debris, aquaculture operations, and other activities may prevent safe passage.

*Predators.* Predators are generally not considered important in limiting killer whale populations. However, scars likely to be from shark bites have been observed on killer whales. Aggressive interactions between residents and transients have been observed. Group living is likely an effective defense against predation. That is, habitat quality must be sufficiently high that large enough groups are supported so that predation is not a factor in recovery.

*Temperature.* While killer whales as a genus are found from polar waters to the tropics, individual populations may experience temperature bounds. These limits may be direct (ability to lose heat when active and retain heat when resting) or indirect (the temperature limits on prey). SRKW's appear limited to temperate waters, and thus temperature may limit the southern extent of the range.

*Intra-specific competition.* Competition with conspecifics can limit habitat quality. The range of Southern Resident Killer Whales may be limited to the north by competition with Northern Resident Killer whales.

*Seasonality.* Due to the migratory nature of salmon, habitat quality varies seasonally, but occupied habitat must support the population year-round. That is, the areas composing critical habitat must include areas sufficient for year-round support, even if the habitat is occupied only briefly. Seasonality of habitat usage will also be important to the economic assessment, as activities may be allowed to proceed provided the portion of the activity that adversely modifies habitat only takes place while whales are absent.

### *Management considerations*

To qualify as occupied critical habitat, special management considerations must contribute to recovery. Management actions regarding the following are likely to affect SRKW's: sediment clean-up, airborne emissions, water quality, fisheries, hatcheries, construction, stream flow, usage of estuary and aquatic habitat, pesticide usage, scientific research, military activities, aquaculture practices, salmon recovery, oil, PCB's, flame retardants, and vessel traffic (routes, discharges, noise, safety, quantity). At least one of the issues (and generally more than one) are likely to affect Southern Resident Killer Whales throughout their range.

### *Proposed Critical Habitat*

Designation of Areas 1-3 as critical habitat seem well supported by the best available science. In addition, all waters in these areas should be included, rather than only waters deeper than 20'. However, Hood Canal may be equal in importance to Puget Sound south of Tacoma Narrows, so perhaps both or neither of these regions should be included. As mentioned above, it might be possible to identify areas likely to qualify as critical habitat in outer coast waters based on the limited available data, and focus research in those areas to allow re-classification if necessary within a few years. A precautionary approach to recovery would allow designation of outer coast waters as Critical Habitat at this time.

If nothing in the ESA precludes designating Critical Habitat in foreign nations, then Canadian waters around the southern part of Vancouver Island should be designated as well. Waters off the northwest portion of Vancouver Island should have the same status as outer coast waters in the US. Waters off the northeast part of Vancouver Island should have the same status as Hood Canal and southernmost Puget Sound. Note that Canada has designated this population as endangered under its Species at Risk Act, seeks to work with the US to recover it, and has proposed US waters to be included in its designation of Critical Habitat. I believe it would help recovery efforts if both nations recognized the same Critical Habitat, including in each others territories.

Some aquatic habitats that historically supported large salmonids but currently don't should be designated as unoccupied Critical Habitat if they have realistic prospects of once again supporting salmon. Such habitat will need to be restored to support an adequate prey base for a viable population of Southern Resident Killer Whales which is essential to the conservation of the species (e.g., removal of the Elwah Dam should allow an increase in salmon production, improving the quality of occupied Critical Habitat, as would removal of dams in the Columbia River watershed that have outlived their usefulness).

As mentioned above, it would be helpful to identify habitat that currently supports prey for Southern Resident Killer Whales. Such habitat could be designated as Critical Habitat in its own right (specific areas outside the geographical area occupied by the species that are essential to the conservation of the species), or managed with regard to potential for adverse modification of occupied Critical Habitat.

### **Specific Comments.**

p. 4. The Resident range extends into Russia, and perhaps Japan.

p. 5. Heyning (1988) said calves begin taking solid food by 6 months. Note that killer whales are rarely pregnant and lactating at the same time, and the mean interval between viable calves is 4 years (Bain 1990), putting an upper limit on mean lactation of just over 2 years (the actual mean will be lower, because lactation is likely to cease before conception, resulting in a resting period). However, Marsh found some pilot whales nurse for many years, and this could be the case for some killer whales as well.

P 5. matriline may span five generations (Bigg et al. 1987, Bain 1988)

p. 7. Au et al. recorded click frequencies much higher than 20 kHz, but these may have been intended to resolve the fine structure of their equipment rather than those typically used under natural conditions.

p. 8. Any behavior in a social setting results in communication. Due to relationships between click interval and distance demonstrated in captive delphinoids, the distance between a whale and its target should be available to all other whales who can hear the clicks. Changes in frequency structure with target size also put information in the outgoing click.

p. 10. The average size value for five species combined is irrelevant if whales don't eat species equally. In addition to the species bias data, there are suggestions that whales prefer large Chinook when feeding on that species. That is, residents may have evolved to feed on perhaps 3 to 5 large Chinook per day, not 25 assorted salmon per day.

p. 11. While temperature does not appear to be a constraint on the genus as a whole, individual populations are likely to be constrained by temperature. For example, populations in the Pacific Northwest are only known from temperate waters. Other populations are only known from sub-tropical to tropical waters. Another population is known only from polar waters.

p. 14. I don't know the "record" for Southern Residents, but I have observed Northern Residents to travel over 100 nautical miles in 20 hours.

p. 20-21. Acoustic data from Dabob Bay suggest Southern Residents rarely use Hood Canal (Josh London, Shaari Unger, personal communications.).

p. 21-26. Some effort information is available, and would help interpret the sighting information. For example, a large number of whale watching boats are based in Victoria, BC,

resulting in a bias for sightings in the northeastern portion of Juan de Fuca Strait relative to the southern and western portions. Effort is greater in the summer than in the winter.

p. 23. Seasonal use is important to the economic analysis, which might be worth mentioning.

p. 26-27. I doubt the 20' contour is a realistic boundary. Northern Residents rub and feed in the intertidal. Southern Residents are likely to feed in kelp beds, and perhaps in the intertidal as Northern Residents do (though that may be limited to the Canadian portion of the range). I think this point will be important, as small projects such as personal docks could probably be constructed without significantly adversely modifying critical habitat. However, such decisions should be based on the degree of habitat modification, not on the assumption that the project does not take place within critical habitat.

p. 27. Conventional wisdom is that use of outer coast waters will be driven by density of Chinook salmon. That is one would expect SRKW's to use habitat where significant returns occur within a short period of time. Further, if topographic features contribute to concentrating runs (e.g., banks), that would increase the likelihood of SRKW's being present. While the data are sparse, it may be worth putting some effort into describing the little information that is available. It would also be worth some discussion of the importance of filling the data gap, the relationship between available funding and the timeline for filling the gap, and the implications of failing to designate critical habitat in this portion of the range until more data become available.

p. 28. Atmospheric deposition accounts for some toxin accumulation in killer whales, but it would not account for differences between Northern and Southern Resident Killer Whales. The residency time of Chinook salmon described by O'Neill probably account for the primary PCB pathway to SRKW's.

p. 29. Data suggesting vessels disrupt foraging in Northern and Southern Resident Killer Whales have been obtained. Recent data from other species support the potential for vessels and other noise sources to disrupt foraging. Data linking noise to stress have also recently been obtained for captive cetaceans. While vessels affect movement on a fine scale, they do not seem to prevent passage through an area nor preclude use of areas beyond the immediate vicinity of a vessel.

p. 30. Haro and Rosario Straits both contain major shipping channels in Area 1.

p. 31. I question whether there is little whale watching in Area 3. While few boats originate in Area 3, boats from British Columbia and other parts of Washington follow whales into this area.